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SOME ADDITIONS TO THE CARBONIFEROUS TERRESTRIAL ARTHROPOD FAUNA OF ILLINOIS.

INSECT remains of Paleozoic age, representing the advent of a class of organisms which is today the largest and most highly specialized of all animal groups, naturally possess an absorbing interest. Unfortunately but few localities have been discovered that yield these fossils, and these have produced but a small number of forms as compared with those of Tertiary and recent time. From the strata of Silurian and Devonian age, insect-remains are so extremely rare that but little can be asserted of them, the bulk of Paleozoic insects being from strata of Upper Carboniferous age. As might be expected, Paleozoic insects often combine in one individual, characters that at the present time are distributed among several orders, and for these synthetic forms which have no living representatives, the name Palæodictyoptera has been proposed by Goldenberg and followed by Scudder.

With the exception of two species preserved in the collections of the Chicago Academy of Sciences, all the material described in the present contribution is in the palæontological collection of the Walker Museum of the University of Chicago, and most of it is from the Gurley collection. With one exception, the specimens are all ironstone concretions, and nearly all are from the famous Mazon creek locality in Grundy county, Illinois. A portion of the collection studied has already been worked over by Dr. S. H. Scudder, and the results of his investigations have been published in a number of his papers, and all that is desired in connection with this portion of the material is to make known the location of the type specimens. Among the remainder of the collection there are several forms of very great interest.

The new forms here described are all more or less closely allied to those already known from America, and the classification here used is that elaborated by Scudder rather than that of Brongniart which was based upon the quite different European insect fauna of Carboniferous times. Most of the new species here recognized are assignable to genera already known —an interesting fact which would indicate that at the early period when these insects lived there were but comparatively few types, and that the number of genera, even in restricted groups, had not reached the specialization of today.

In the preparation of this paper, acknowledgment is due to the cheerful aid of Professor Stuart Weller, of the University of Chicago, and to the generosity of Curator F. C. Baker, of the Chicago Academy of Sciences, for the loan of specimens belonging to that institution.

CLASS *ARACHNOIDEA.*

ORDER *ANTHRACOMARTI.*

Family *Architarboidae* Karsch.

The genera of this family may be separated in the following manner:

Legs unusually long and slender: basal abdominal segments large: spinneretts present - - - - - - - - **Kustarachne**
Legs thickened; basal ventral segments of the abdomen usually shortened; no spinning organs - - - - - - - - - - 2
2. Coxæ radiating from a triangular sternum - - **Anthracomartus**
Coxæ radiating from a median pit or ridge - - - - - - 3
3. Basal segments of abdomen strongly angulated; cephalothorax prominent, not markedly constricted from the abdomen - **Geraphrynus**
Basal segments nearly transverse, though often crowded - - 4
4. Cephalothorax narrower than the abdomen, or markedly constricted from it, suborbicular, the front more or less broadly angulate 5
Cephalothorax shorter than the abdomen, but not constricted from it, transversely orbicular, the front rounded - - **Architarbus**
5. Cephalothorax less than one-half as broad as the abdomen; legs short; large species - - - - - - - **Hadrachne** gen. nov.
Cephalothorax and abdomen of nearly equal breadth; legs comparatively long though stout; species less than one-half the size of the former - - - - - - - - - - - **Geratarbus**

Hadrachne gen. nov.[1]

Stout-bodied; cephalothorax small, angulate anteriorly and transverse posteriorly, its sides nearly straight and more or less continuing the outline of the abdomen without a lateral con-

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[1] *ἀδρός*, "stout;" *ἀράχνη*, "spider."

striction between the two. Post-thoracic plate broadly triangular, but not crowding the basal abdominal segments so that they become angulate. Abdomen greatly enlarged, regularly oval, broadest at the middle, consisting of nine segments. Legs short, coxæ wedge-shaped, radiating from a small central disc.

1. **Hadrachne horribilis**, sp. nov. (Plate V, Fig. 1; Plate VII, Fig. 1).

The cephalothorax is triangular in outline, bluntly pointed in front. Its texture shows no punctation nor other sculpturing. The sutures between the pedigerous segments are finely indicated and converge to a small elliptical, longitudinally disposed central space which may indicate a shallow depression or lie level with the surface. Unfortunately, as in its relatives, although the dorsal surface is exposed, no traces of eyes can be observed. The posterior plate of the thorax has its surface granular. As in its allies, it is crenulate, the ridges curving anteriorly. The post-thoracic shield overlying the base of the abdomen is broad and shallow, its posterior edge quite obtusely rounded, rather than angulate; its surface is impunctate. The six basal segments of the much-swollen abdomen occupy nearly one-half of the body, and are of nearly equal size. At the margin they are widest, and become narrower at the middle to accommodate the post-thoracic shield. The sixth segment is but slightly bowed. These segments are finely punctulate and possibly may have been smooth. The apical half of the abdomen, however, is decidedly granular, the granules becoming irregular, confused, and confluent apically. No anal tubercle is visible. The incisures of the segments do not interrupt the outline of the abdomen. The lateral sulcus extending longitudinally is evident. The legs are remarkably short and slender for so stout a creature. Palpi similar to the legs, equally stout, but somewhat longer. The coxæ consist of closely contiguous, distally expanded, wedge-shaped pieces, which meet about a small median inclosure. The remaining segments of the legs are individually stout, not over twice as long as broad.

Length of whole spider 39^{mm}, of cephalothorax 13^{mm}, of abdomen proper 20^{mm}; breadth of cephalothorax at base 14^{mm}, of abdomen at middle 23^{mm}; length of leg-joints 3.5^{mm}.

A single specimen represented by one-half of an ironstone nodule from Braidwood, Ill., collected by Mr. M. Fischer. This is by far the largest Anthracomart-spider yet discovered. The great size of the abdomen and the contrastingly small cephalothorax will readily distinguish it from the other genera of the order.

Type. Pal. Coll. No. 9232.

2. **Geraphrynus carbonarius** Scudder (Plate V, Fig. 3; Plate VII, Fig. 3). *Proc. Am. Ac. Arts Sc.* Vol. XX (1884), pp. 16, 17.

A beautifully preserved specimen of this common species, measuring 24^{mm}, exhibits nothing unnoticed in Dr. Scudder's lengthy description. The post-thoracic piece is triangular.

Pal. Coll. No. 9233.

3. **Architarbus rotundatus** Scudder (Plate V, Fig. 2; Plate VII, Fig. 2). *Geol. Surv. Ill.*, Vol. III (1868) , p. 568, Fig. 4.

A well-preserved specimen, showing nearly the whole of the legs and the structure of the body, appears to belong to this species.

Pal. Coll. No. 9234.

4. **Kustarachne sulcata** sp. nov. (Plate V, Fig. 5; Plate VII, Fig. 4).

Cephalothorax orbicular, nearly as broad as the abdomen, from which it is evidently, though not deeply, constricted. Coxæ meeting along a narrow median space which extends along the whole length of the cephalothorax, stout, distinctly and deeply punctulate; remainder of legs punctulate also, more slender than the coxa, especially on the tarsal portion; metatarsus as long as the basal portion of the leg together. Mouth parts not distinct. Abdomen somewhat broader than the thorax, elongate elliptical, its segmentation obscured, irregularly but deeply punctulate, the punctures becoming obsolete in the middle, provided with a prominent lateral sulcus concentric with and close to the margin, and with a broader and deeper longitudinal one on the disc on each side of the middle. Abdomen terminated by a triangular sessile pygidium consisting of two and possibly three subsegments, its outline extending beyond the regular oval of the abdomen, not punctured. The basal appendages noticed in *tenuipes* are not indicated, but there is a mark on the stone which might have been caused by a terminal seta. This is as fortuitous as in the other species, but its presence casts even darker gloom over the systematic position of the genus.

Length of body 15^{mm}, width of cephalothorax 6.5^{mm}, length of abdomen without the pygidium 9^{mm}, width of abdomen 7^{mm}, width of first subsegment 2^{mm}, length of second leg (imperfect) 24^{mm}, width of second leg beyond body $0.75–0.3^{mm}$.

Carboniferous. Mazon creek, Illinois.

Type. Pal. Coll. No. 9235.

Although the imperfect type of this genus offers but few salient characters, the present form is placed congeneric with it in entire confidence. It concurs with the characters of no other Anthracomart, but agrees with *Kustarachne tenuipes* in its general form, slender, elongate, but somewhat stouter legs, and similar pygidium. However, it is quite distinct in the sculpture of the abdomen.

5. **Kustarachne exstincta** sp. nov. (Plate V, Fig. 4; Plate VII, Fig. 5).

A single specimen in fragmentary condition. Cephalothorax confused, apparently transversely rounded; the coxæ large and meeting about a deep central depression; the post-plate (if there be one) not indicated. Abdomen rounded oval, its segmentation rather distinct; seven and possibly eight segments indicated, of which the basal segments are longer than the apical, the diminution in size being gradual. The last three segments are outlined by an impressed line. At the termination of the abdomen is a triangular two-jointed pygidium with a prominent mammilliform spinnerett on each side of the last segment. At some distance beyond the body there is an indication of a slender setiform appendage, though whether this is a portion of the post-abdomen or a fragment of a tarsus cannot be ascertained. The latter view seems more likely the correct one, and would also explain the "post-abdomen" of the other species. The lateral sulcus is vague, but seems to be distant from the margin of the abdomen; this may be due to the crushed and contorted condition of the fossil. No median grooves or ridges: surface of the body minutely and densely punctulate, the punctures much finer and denser than in *sulcata*. Legs vaguely indicated as scattered fragments. What remains shows them to have been excessively long and slender; the strong flexure at the coxal joints and the absence of the middle parts of the legs would indicate that the body was carried much as with the Phalangidæ of today.

Length of body 14^{mm}, length of abdomen 9^{mm}, breadth of abdomen (approximate) 7^{mm}, breadth of cephalothorax (approximate) 5^{mm}.

Mazon creek, Illinois. Carboniferous.

Type. Pal. Coll. No. 9236.

This genus possesses some of the characters of the Anthracomarti and some of the true spiders. The formation of the coxal plates is quite suggestive of the former order, while the peculiar segmentation of the abdomen—the basal segments being as large or larger than the apical—and the possession of what are possibly spinning organs are equally incongruous for the group. But two true spiders are known from Carboniferous times, both discovered in Europe. The best-known of these, *Protolycosa anthracophila* F. Roemer, has abdominal appendages and distinctly segmented abdomen. The other, *Palaranea borassifolia* Frič, is fragmentary, but seems to be devoid of these appendages. Even if the appendages at the end of its abdomen be interpreted as spinning organs, *Kustarachne* cannot be included with these, as its relationships are closer with the Anthracomarti, as can be seen by its sessile abdomen and the arrangement of its coxæ. It would seem as if this genus, of which the three species agree pretty closely, was in the line of descent from the ancestors of both the Anthracomarti and the Araneæ, related more closely to the former, but sufficiently removed to be considered now as equivalent to the other genera of the group together.

Although archaic, *Kustarachne* is not ancestral. Even at this early period it had attained a certain degree of specialization in the loss of its abdominal legs, the anchylosis of the basal segments of the abdomen, and the peculiar development of its legs. But that it was not so highly organized as its contemporaries can be surmised from the imperfect fossil remains. Like many archaic or young types, its body-chitinization is not complete, and its frailer structure is represented but vaguely in the same rocks that bear such excellent witness of the rulership of the scorpion and the Anthracomart.

ORDER *SCORPIONES*.

Family *Eoscorpionidae* Scudder.

6. **Eoscorpius carbonarius** Meek and Worthen.
Geol. Surv. Ill. Vol. III, p. 560, text figure.

This specimen is the reverse of the one illustrated by Meek and Worthen, being the opposite portion of the same ferruginous concretion.

Cotype. Pal. Coll. No. 8949.

CLASS *INSECTA*.

DIVISION PALÆODICTYOPTERA Goldenberg.

SECTION ORTHOPTEROIDEA Scudder.

Family *Palaeoblattariae* Scudder.

7. **Mylacris Gurleyi** Scudder.
Bull. U. S. Geol. Surv., No. 124 (1895), p. 43, Plate I, Fig. 5.

Type. Pal. Coll. No. 6389.

8. **Mylacris Mansfieldi** Scudder.
Mem. Bost. Soc. Nat. Hist., Vol. III, p. 47, Plate 5, Fig. 15.

This is the specimen mentioned by Scudder as coming from Vermilion county, Ill., the original type of the species being from Cannelton, Pa.

Pal. Coll. No. 9237.

9. **Promylacris ovalis** Scudder.
Proc. Ac. Nat. Sci., Phila., 1885, pp. 34, 35.

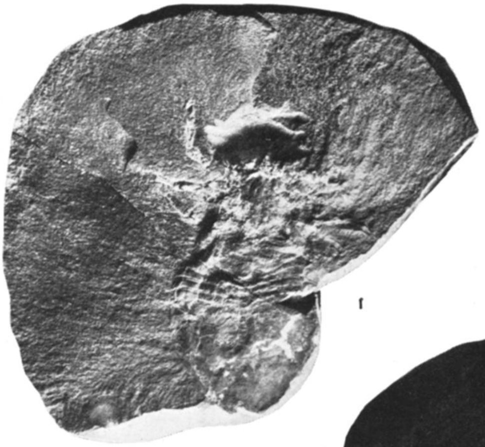
Type. Pal. Coll. No. 6387.

Another well-preserved specimen of slightly smaller size appears to belong with this species. It comes from the same locality and the same formation.

Pal. Coll. No. 9238.

10. **Lithomylacris simplex** Scudder.
Mem. Bost. Soc. Nat. Hist., Vol. III (1879), pp. 51, 52, Plate 5, Fig. 5.

Type. Pal. Coll. No. 6390.



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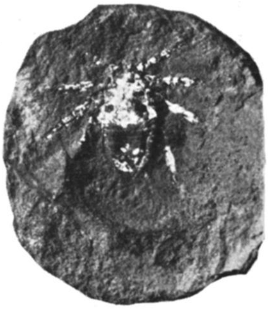

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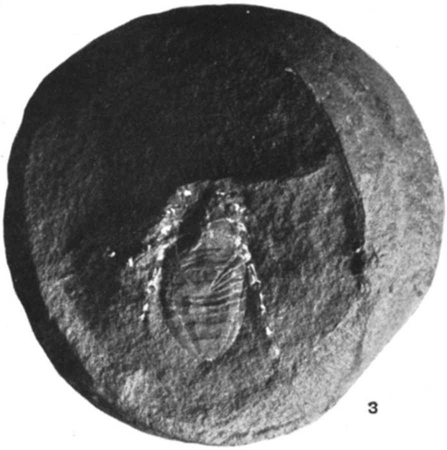

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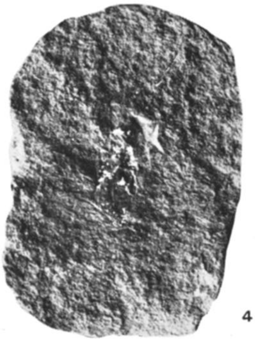

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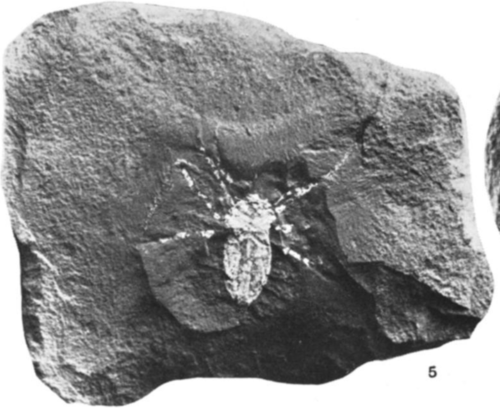

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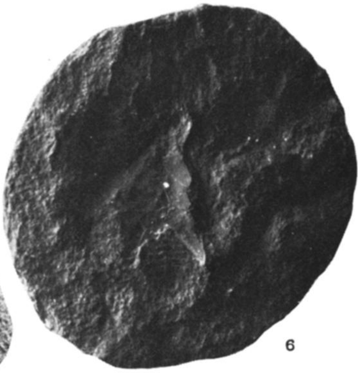

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11. **Mylacridae sp.**

Scudder, *Bull. U. S. Geol. Surv.*, No. 124, p. 55, Plate II, Fig. 4.

This is supposedly the humeral angle of the tegmen of a gigantic cockroach.

Figured specimen. Pal. Coll. No. 8948.

The collection contains a large and rather well-preserved specimen of *Dipeltis diplodiscus* Packard (*Am. Nat.* 1885, p. 293), measuring nineteen millimeters in length. The remarkable resemblance between this supposed Phyllopod crustacean and a nymph or wingless female of the cockroaches can be seen from the accompanying figures of the species. (Plate V, Fig. 6; Plate VII, Fig. 6.)[1]

Family *Protophasmidae* Brongniart.

12. **Paolia Gurleyi** Scudder (Plate VII, Fig. 7).

Proc. Am. Acad. Arts Sc., Vol. XX, p. 173.

This interesting specimen, found in a whetstone from French Lick, Orange county, Ind., is here figured for the first time.

Type. Pal. Coll. No. 6393.

13. **Dictyoneura clarinervis** sp. nov. (Plate VI, Fig. 1; Plate VII, Fig. 8).

Wing. Length 33^{mm}; greatest breadth, at middle, 10^{mm}; rather pointed. Humeral angle explanate, filled with very oblique cross-veins from the mediastinal vein; mediastinal oblique and vanishing at the end of the middle third of the wing. Scapular vein parallel with and not distant from the mediastinal, ending in the costa about one-seventeenth the distance from the tip at a slight indentation marking the termination of the marginal vein; near its extreme base the scapular vein emits a lower branch unevenly divaricating from the main stem and furcating just before the last third, the lower branch trifurcating toward the tip and ending at the wing-apex. Externomedian vein not well indicated at the base, owing to the plication of the wing; it furcates once near the point of branching of the lower scapular vein and possibly is split near the tip. Internomedian vein simple, sharply delineated. Anal vein extremely prominent, filling nearly the whole of the hind half of the wing, emitting four downward offshoots within the wing-area, of which the first and fourth are basally furcate, and one from the anal angle. All the veins are connected by rather distant cross-veins or scrobiculi, which are strongly oblique, though in a sense opposite to those anterior to the mediastinal.

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[1] In a paper just issued E. H. SELLARDS assigns this species to *Mylacris* (*Am. Jour. Sc.*, April, 1903, p. 309). The shape of the pronotom agrees very well with *Promylacris rigida* Scudd.

Found in an ironstone nodule six miles southeast of Danville, Ill., at Grape creek, by Mr. W. F. E. Gurley.

Type. Pal. Coll. No. 9240.

This species, while clearly belonging to the genus *Dictyoneura* in the restricted sense of Scudder, not of Brongniart, is markedly distinct from its congeners in the great development of the anal vein. This vein has over twice as many branches as in any of the other species. This is the first American form, all the others being European from the Saarbruck basin.

SECTION NEUROPTEROIDEA Scudder.

Family *Homothetidae* Scudder.

14. **Didymophleps contusa** Scudder.

Mem. Boston Soc. Nat. Hist., Vol. III. pp. 330, 331, Plate 29, Fig. 6.

Type. Pal. Coll. No. 6392.

15. **Cheliphlebia extensa** sp. nov. (Plate VI, Fig. 2; Plate VII, Fig. 9).

Body elongate, slender, subcylindrical, of moderate size. Head narrow, comparatively small. Prothorax narrow and prolonged. Legs rather robust. Wings large, overlapping on the abdomen, broadest at the beginning of the outer fourth; costal margin nearly straight; apex of wing broadly rounded; mediastinal vein very short; scapular vein long, extending to near the tip of the wing, parallel with the costa, connected with the marginal by a series of moderately close, oblique, curved, simple cross-veins. Externomedian vein first forked at the middle of the wing; its lower stem simple, its upper again forked, and each branch again dichotomizing, the upper twice, the lower once. Internomedian vein emitting a number of gently curved, rather distant, oblique branches from its lower side, parallel with those of the externomedian, and filling the hinder portion of the wing. Cross-veins feeble or possibly wanting altogether, except those on either side of the scapular vein.

Head subquadrate, small, slightly longer than broad, and somewhat broader in front of the eyes, its sides otherwise nearly parallel; posterior angles rectangular, but little rounded; mandibles triangular, short, though strong, much curved on their outer border, pointed; eyes prominent, elongate, narrowly extending along the sides of the head. Head with a broad median longitudinal carina. Antennæ slender, setiform. Prothorax slender, nearly twice as long as the head, divided at the middle by a transverse sulcus. The anterior part of the prothorax is of slightly less breadth than the posterior, its front edge straight. Front coxæ comparatively small, attached to the sternum just behind the transverse sulcus, not contiguous on the median line; remainder of the front legs vague. The indications show them to be short and robust. Mesothorax as long as the head, slightly broader than long, quadrate, simple; the middle legs are attached at the posterior part of this segment, and also are vaguely defined. Metathorax of equal length with the mesothorax, but of gradually increasing breadth, its hind edge circularly excised for the intermediary segment; hind coxæ large, prominent, globoso-quadrate, marked with fine longitudinal striæ, hind femora but twice the length of the coxæ, apparently much compressed, marked with longitudinal furrows on the sides and more or less sulcate for the reception of the slender, outwardly bowed tibiæ; tarsi long and slender, the last joint expanding, elongate obcordiform; claws and empodium visible, one-half the length of the last tarsal joint. Abdomen subcylindrical, slender, slightly longer than the head and thorax together, consisting of eleven segments, including the intermediary segment, gradually tapering to the middle (sixth segment), then suddenly narrowed on the next two segments, thence subparallel to the tip. Anal cerci visible, apparently about one-half the length of one of the segments of the abdomen. Wings long, overlapping over the abdomen, two and one-half times as long as broad, veins fine; costal margin nearly straight, especially on the middle third of the wing; anal margin vaguely defined; apex of wings apparently rounded. Mediastinal vein short, not appearing in the faint basal impression of the wing; scapular vein nearly conforming with the costal curvature, meeting the margin at the outermost eighth of the wing, and connected with the faint marginal vein by a series of about eighteen oblique, curved, simple cross-veins; externomedian vein separated from the scapular by a rather broad interval, its five or six branches filling out the apex of the wing; internomedian vein feeding the greater part of the hind margin with equidistant simple branches; anal veins numerous, straight, simple, indicating a rather full anal area. Hind wings apparently of the same structure as the fore ones, and of nearly the same extent. The venation is obscured.

Length of body from base of mandibles to end of last abdominal segment 41^{mm}, mandible 0.7^{mm}, head 3.7^{mm}, prothorax 8.3^{mm}, mesothorax 5^{mm}, metathorax 3.5^{mm}, abdomen 21^{mm}, anal cercus 1.2^{mm}, hind coxa 3^{mm}, hind femur 6.8^{mm}, hind tibia 5.5^{mm}, hind tarsus 5.5^{mm}, front wing 32^{mm}, hind wing 26^{mm}, breadth of head 3^{mm}, prothorax 3.5^{mm}, mesothorax 6^{mm}, metathorax 6.7^{mm}, sixth abdominal segment 5.5^{mm}, eighth abdominal segment 3^{mm}, wing at widest part 12^{mm}.

Carboniferous. It was found as an opened iron-stone nodule at Mazon creek, Illinois, only one-half of the concretion being obtained. It represents the dorsal aspect of the insect, and is partially water-worn.

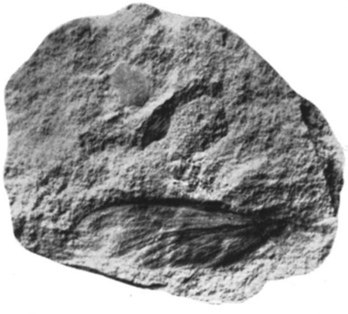
This species seems to have its nearest relative in *Cheliphlebia elongata* Scudder, from the same formation, conforming best with the venation of that species. However, the present form differs in the brevity of the mediastinal vein, the narrow scapular area, and the course of the externomedian vein.

The hind legs are stouter than usual for a neuropteroid insect, with ridges and sulci reminding one somewhat of the sculpture of an orthopterous leg. The swelling of the central part of the abdomen would indicate that the specimen is a female with the basal half of the abdomen distended with ripened ova. The prominence of the tenth abdominal segment shows that the abdomen was carried with a dorsal hump and with the tip directed ventrally, somewhat in the manner of living female Embiidæ of today.

Type. Pal. Coll. No. 9241.

16. **Eucaenus mazonus** sp. nov. (Plate VI, Fig. 3; Plate VII, Fig. 10).

Broad-winged species; prothorax longer than broad, meso-



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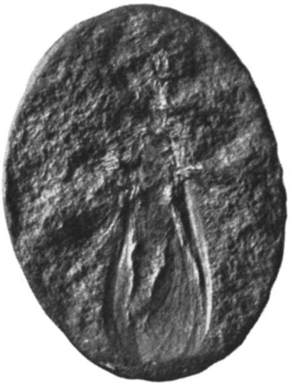

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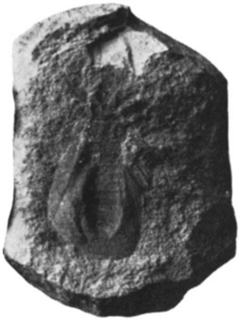

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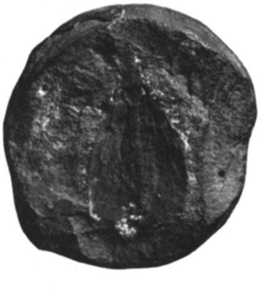

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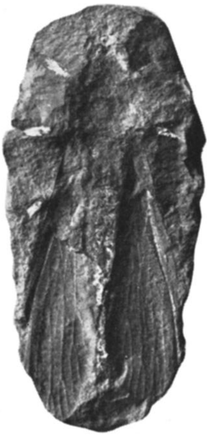

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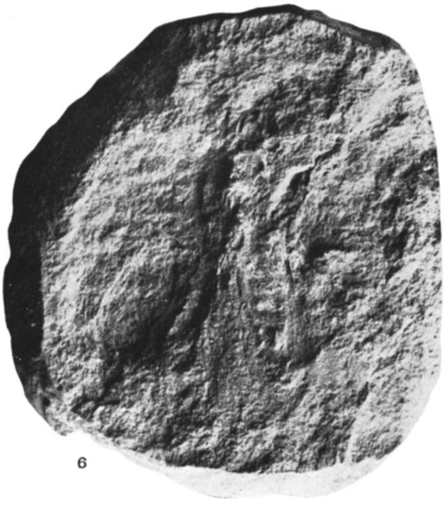

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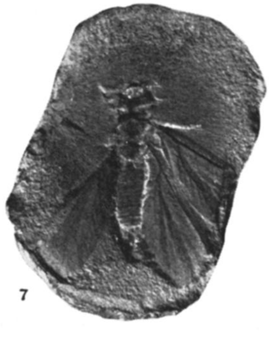

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and metathorax quadrate. Abdomen elongate-ovate, no median keel present. Wings very broad. Legs short, moderately strong, punctulate.

Head ovate, about two-thirds as long as the prothorax, rounded on the posterior angles; eyes bulging, hemispherical, not large; mouth-parts not defined. Prothorax broadly ovoid, rounded behind, straight in front; meso- and metathorax gradually broader posteriorly, their side angles rectangular. Abdomen broad, elongate-oval, more or less depressed, consisting of ten segments, including the segment mediaire, broadest at the sixth segment, and then gradually and broadly rounded to the tip; only the base of the anal stylets visible; last segments not carinate. Legs short, femora stout, compressed; femora and tibiæ minutely and closely punctulate: on the forward side of each femur is a longitudinal boss near the inferior edge. Wings very broad, longer than the abdomen; the costal margin evenly rounded, except at the axillary angle of the hind wings, where it is strongly shouldered; mediastinal vein straight, oblique, distant from the marginal at its base and connected with it by numerous oblique, straight cross-veins; scapular vein close to the mediastinal, the other veins obliterated. Under wings with numerous branches to the externomedian.

Length of body 24^{mm}, of prothorax 4.5^{mm}, of mesothorax 3^{mm}, of metathorax 3.4^{mm}, of abdomen 10^{mm}, of fore wing 20^{mm}, of front femur 3.3^{mm}, of hind femur 6.3^{mm}, of hind tibia 3.5^{mm}. Breadth of prothorax 3^{mm}, of mesothorax 3.8^{mm}, of metathorax 4.7^{mm}, of sixth abdominal segment 5.5^{mm}, of front wing 8^{mm}.

Described from a specimen represented on both sides of an ironstone nodule from the Carboniferous beds at Mazon creek, Illinois.

This species seems certainly to be congeneric with *ovalis* Scudder, and may possibly be the same form. In some respects the state of preservation is better than that of Dr. Scudder's specimen, portions of the head and legs being visible, but the neuration is more obliterated. The shape of the prothorax and of the wings will distinguish this species from *ovalis*. The outline of the body is suggestive of a rather large Reduviid bug, with broad wings, rather than of a neuropteroid insect.

Type. Pal. Coll. No. 9242.

In the collection is another specimen (No. 9246) exhibiting the base of the head, the meso- and metathorax, and the base of the abdomen, together with a portion of the wings. The insect is of the same size as the specimen previously described, and appears to belong to the same species. Nothing further can be supplied to the diagnosis by the characters exhibited by this fossil. In its broadened wings the straight mediastinal and scapular veins alone are clearly cut, the other veins being indefinitely preserved.

17. **Eucaenus attenuatus** sp. nov. (Plate VI, Fig. 4; Plate VII, Fig. 11).

Head indefinite, but with a median carina; prothorax more or less quadrate, its sides nearly parallel; mesothorax transversely quadrate, much broader than long; metathorax and abdomen indefinite, but stout, ovate-pointed caudally; abdomen with nine uniform segments, the apical small, the last two segments with a sharp median keel. Legs compressed, rather short and stout, minutely punctate, the hind tarsi longer than the tibiæ. Wings large, not abrupt at the humeral angle, uniformly elongate-oval; mediastinal vein nearly straight, oblique, meeting the costa at the outer three-fourths, provided with numerous oblique cross-veins to the margin; scapular vein close to the mediastinal, parallel with it, and slightly curved so that the wing-margin and the scapular vein outline an elongate spindle-shaped area; the remaining veins obliterated.

Length about 28^{mm}, length of wing about 25^{mm}, breadth of wing 9^{mm}.

One specimen, an ironstone concretion from the Egan collection of the Chicago Academy of Sciences, No. 4749. Mazon creek.

The three species of this genus show the following interrelationship:

Last abdominal segments provided with a median keel - - - - 2
Last abdominal segments not carinate, costa and scapular vein opposedly curved - - - - - - - - - - *attenuatus* sp. nov.
2. Scapular vein curved in an opposite sense to the costal margin *mazonus* sp. nov.
Scapular vein subparallel with the margin - - *ovalis* Scudder

Petromartus gen. nov.[1]

Head small, with prominent mandibles. Prothorax elongate; meso- and metathorax quadrate. Abdomen stout, tapering beyond the middle and provided with prominent sexual organs on the antepenultimate ventral segment. Legs rather stout. Wings long, exceedingly slender, rather triangular in outline, broadest at the beginning of the outermost third where the hind margin forms an obtuse angle; neuration simple, nearly straight; mediastinal vein long; scapular simple, unbranched. Externomedian several times branched; internomedian of similar formation. All the veins extend straight from the narrow base and evenly fill out the apical portion of the wing with a gentle curvature. Numerous well-marked and distant transverse cross-veins connect the longitudinal veins. Underwings similar, but probably broader. Wings overlapping the abdomen when at rest.

18. **Petromartus indistinctus** sp. nov. (Plate VI, Fig. 6; Plate VII, Figs. 12, 13).

Male.—Elongate slender insect with thickened abdomen, and very narrow fore wings. Head quadrate, longer than broad; mandibles prominent. Prothorax slender, elongate, provided with a transverse sulcus in front of the middle; sides and posterior edge margined. Mesothorax broader, rectangular, bearing the fore wings at the hind angles. Remainder of thorax and base of abdomen obscured. Abdomen broad, elongate, consisting of ten segments, including the mediary segment, which is supposedly present. At the eighth segment is a large and broad ventral tubercle bearing a pair of clasping valves which meet in a mid-longitudinal line. The sexual apparatus of the last segments and the caudal appendages are obliterated. Legs imperfectly preserved; femora compressed, their sides flat, twisted in position as described for the other species. Front wings more slender than the hind ones and comparatively smaller; veins straight, connected by numerous strong cross-veins; venation reconstructed as follows: mediastinal vein extending two-thirds to the wing-tip; scapular vein straight, parallel with the mediastinal, and connected with it by numerous transverse veins. These cross-veins, while angular at the scapular vein, are prolonged to meet the rather distant main branch of the externomedian. The externomedian vein arises close to the scapular and continues parallel with it to the middle of the wing, when it is deflected downward so as to terminate at a distance from the scapular and at the tip of the wing. At the point of flexure it sends off a simple underbranch. Internomedian and anal veins confused, probably simply furcate and nearly parallel with the straightened and uninflated hinder margin. The under wings are broader and comparatively fuller than the upper, neuration probably nearly similar, but the veins less crowded basally.

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[1] *πέτρος*, "a stone;" *μάρτῠς*, "a witness."

Length 47^{mm}, length of head 5^{mm}, of mandible 1.25^{mm}, of prothorax 6^{mm}, mesothorax 4.5^{mm}, metathorax 4.5^{mm}, abdomen 27^{mm}, front wing 40^{mm}. Breadth of head 3^{mm}, of prothorax 3.5^{mm}, mesothorax 5.5^{mm}, metathorax 9^{mm}, fourth abdominal segment 7^{mm}, eighth abdominal segment 6^{mm}, front wing 8^{mm}. These measurements are approximate.

Both halves of an ironstone nodule discovered by Mr. William F. E. Gurley at Petty's Ford, Little Vermillion river, fourteen miles southeast of Danville, Ill. This is the same locality where *Termes contusus* Scudder and *Propteticus infernus* Scudder were found.

The metapleuræ have burst apart from the notum in the specimen, so that the hind wings are torn from their normal position. Thus above the abdomen four thicknesses of the wings are superimposed. From the narrowness of the fore wings we might surmise that these early insects were not powerful flyers, but flitted much as the damsel-flies or stone-flies do today.

Judged by the shape of the wings, with their strong distant cross-nervures, this form would be located near the genera *Woodwardia* and *Sphecoptera* of Brongniart, and placed in his family Megasecopterida. However, as this family coincides more or less with Scudder's Hemeristina, which is defined in more specific terms, it appears that the new form would be incongruous with its fellows. The elongate prothorax, the outline of the abdomen, and the course of the longitudinal veins more nearly correspond with the family Homothetidæ Scudder.

Its position in this group may be seen by the table given herewith. At any rate, we find here another link connecting the European fauna with that of America.

Type. Pal. Coll. No. 9243.

The relationships between the insects of this family can be quickly seen from the following conspectus arranged from the descriptions of the genera:

Mediastinal vein terminating before the middle of the wing - **Cheliphlebia**
Mediastinal vein extending beyond the middle of the wing - - 2
2. Mediastinal vein extending parallel with the marginal - - - 3
   Mediastinal extending obliquely to the marginal - - - 5
3. Wings excessively narrow, provided with strong and distant cross-veins - - - - - - - **Petromartus** gen. nov.
   Wings less narrow, cross-veins less evident - - - - - - 4
4. All the veins up to the internomedian parallel with the straight margin; branches of the internomedian oblique, parallel - **Didymophleps**
   Veins more irregular; scapular branched near the tip - **Acridites**
5. Costal margin nearly straight - - - - - - - - - 6
   Costal margin bowed outwardly - - - - - - - - - 7
6. Mediastinal without oblique branches, scarcely shorter than the scapular - - - - - - - - - - **Homothetus**
   Mediastinal with branches, extending two-thirds the length of the wing; scapular reaching nearly to the tip; cross-veins wanting **Anthracothremma**
7. Branches of the mediastinal and scapular veins crowded, similar **Eucaenus**
   Branches of these veins dissimilar, uncrowded - - - - 8
8. Front wings obovate; branches of mediastinal simple, rather distant **Gerapompus**
   Front wings less markedly ovate; some of the branches of the mediastinal forked - - - - - - - - - - 9
9. Internomedian vein with numerous branches like those of the externomedian - - - - - - - - - **Genopteryx**
   Externomedian vein far separated from the scapular, its branches more important than those of the internomedian - **Genentomum**

Family *Palaeopterina* Scudder.

19. **Dieconeura maxima** sp. nov. (Plate VI, Fig. 5 ; Plate VII, Figs. 14–16).

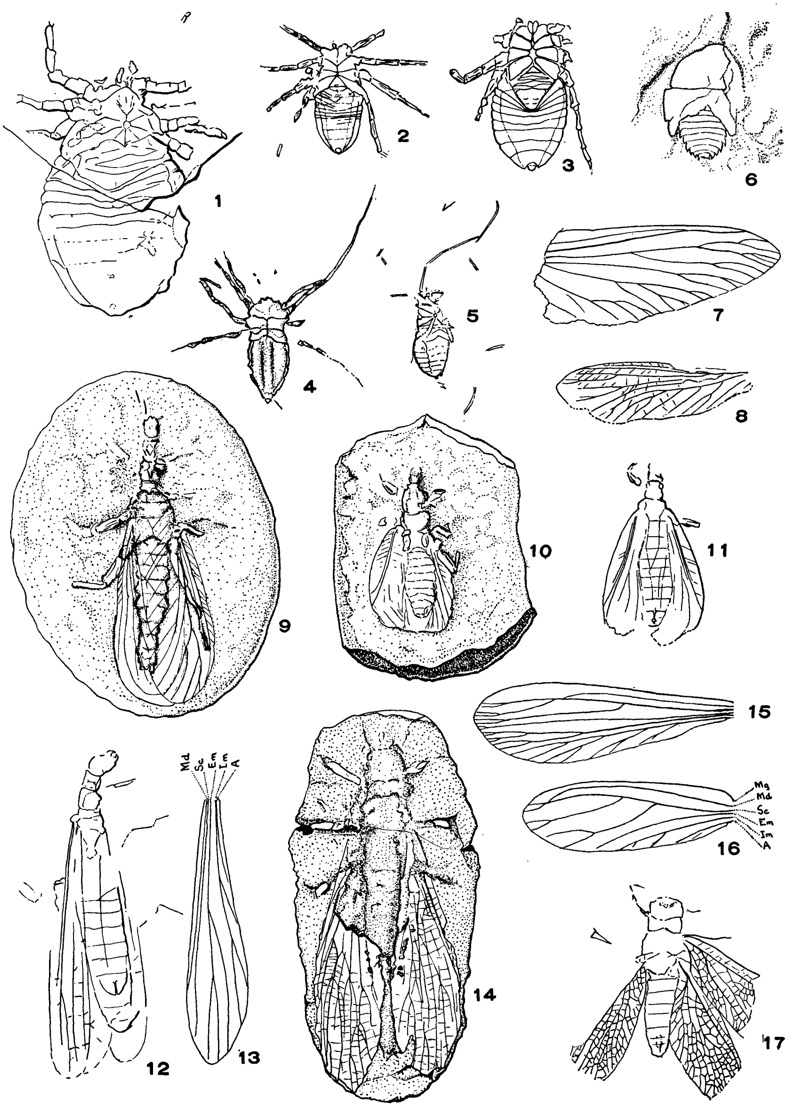
Large, elongate. Wings long, narrow, broadest at the beginning of the outermost fourth, costa nearly straight; of the fore wings the mediastinal vein is parallel with and close to the marginal, ending in the scapular somewhat beyond the middle of the wing; scapular vein forked before the middle of the wing, the upper branch parallel with the costal margin, emitting a simple under branch, the lower branch simple or simply forked, nearly straight, rather distant from the upper and apically parallel with it. Externomedian vein simple, terminating near the tip of the wing. Internomedian forked at the middle of the wing, each branch simply forked near the tip. The main stem of the anal vein is more or less parallel with the hind margin, terminates in the margin at the beginning of the apical sixth of the wing, and sends a number of lower branches to the hind margin, which are simple or simply forked. Neuration of the hind wings nearly similar; the mediastinal is strong and deeply set in the explanate costal portion; scapular vein more important than in the fore wings, the divarication of its principal branches occupying a large part of the wing and filling the apical portion; remaining veins much reduced. Both wings filled with numerous cross-veins.

Body indefinitely preserved, but indicating a slender, *Corydalis*-like insect. Prothorax rounded in front, its sides parallel behind; mesothorax broader, quadrate; metathorax and abdomen vague, their segmentation scarcely visible. Wings surpassing the abdomen, their hind margins touching above the abdomen, but the wings do not overlap. Neuration of both pairs well preserved in large part. The femora of all the legs are in part indicated, and show that they were provided with prominent longitudinal ridges.

Length about 62^{mm}, length of thorax (pro-) 8, (meso-) 7, and (meta-) 7^{mm}, length of abdomen 31^{mm}, length of front wings 45^{mm}, breadth of front wings 15^{mm}.

The assignment of this species to the genus *Dieconeura* is quite permissible on account of the similarity between the wing-neuration of the different species. But it must be remembered that the new form is considerably the largest that has been placed here. The dissimilarity between the two pairs of wings, which is shown in the somewhat diagrammatic reconstruction, is rather striking for an insect of pre-Tertiary times. The interpretation of the neuration is quite likely the correct one, as large portions of the veins of both wings are well indicated on the fossil.

Plate VII



The three species just described show a marked agreement in the resting position of the hind legs. In each case the femur is twisted in such a manner that the tibia is directed forward and away from the body. This primitive attitude is retained by a few insects of today, such as stone-flies, earwigs, the Embiidæ, *Gryllotalpa*, etc., and by the nymphs of many neuropterous insects.

Carboniferous, Mazon creek.

Type. Pal. Coll. No. 9244.

20. **Propteticus infernus** Scudder.

Mem. Boston Soc. Nat. Hist., Vol. III, pp. 334–6, Plate XXXI, Figs. 3, 4.

Type. Pal. Coll. No. 6391.

The following dichotomy will serve to assist in the assignment of the genera of this group:

Internomedian vein ending in the middle of the lower margin, with numerous branches arising from its upper side - - - **Strephocladus**
Branches of internomedian springing from below; if from above not ending in the hind margin - - - - - - - - - - - - 2
2. Internomedian with an adventitious vein running across the externomedian into the scapular - - - - - - **Aethophlebia**
Internomedian of regular formation - - - - - - - 3
3. Externomedian unforked, following the course of the internomedian **Dieconeura**
Externomedian forked - - - - - - - - - - - 4
4. Scapular vein close to the mediastinal, straight, its principal branch arising near the middle of the wing and nowhere far removed from the stem - - - - - - - - - - - **Miamia**
Scapular vein bent, separated from both the mediastinal and its principal branch - - - - - - - - - **Propteticus**

Family *Hemeristina* Scudder.

Protodictyon gen. nov.[1]

Body short, very robust. Pro-, meso-, and metathorax quadrate, broad. Abdomen robust, the last segments provided with a median keel. Wings, large, broad, mediastinal vein ending in the costa beyond the middle; scapular vein strong, parallel with the mediastinal, emitting a distant under-branch near the base of the wing, which dichotomizes several times in an irregular manner. Externomedian vein contiguous with the scapular stem on its basal portion and then suddenly deflected.

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[1] πρῶτος, "earliest;" δίκτυον "net."

It also dichotomizes irregularly and often. Internomedian and anal veins much reduced. Cross-veins numerous, forming a more or less complete reticulation.

21. **Protodictyon pulchripenne** sp. nov. (Plate VI, Fig. 7; Plate VII, Fig. 17).

Head not indicated. Prothorax large, square, the sides biarcuately sinuate, meso- and metathorax transversely quadrate, narrower than the prothorax; abdomen robust, nine segments visible, the eighth and ninth with a short median keel. Beyond the abdomen are well-preserved indications of two long setiform appendages. Legs vaguely represented, but apparently quite long. The beauty of this specimen, however, lies in the excellent preservation of the wing-neuration, which is clearer cut than in any fossil of its kind yet discovered. Every vein, branch, and cross-nervure is as clearly depicted as in the living insect. Wings full, large as compared with the length of the insect, costal margin nearly straight: mediastinal, scapular, internomedian, and anal areas much reduced; externomedian and scapular veins prominent, occupying the larger part of the wing; mediastinal vein subparallel with the margin, ending in it considerably beyond the middle of the wing. Main scapular stem nearly straight, prominent, gradually converging with the margin and ending three cross-veins beyond the tip of the mediastinal; near the basal fifth the scapular sends down a widely diverging branch, which then continues toward the wing tip, anastomosing in numeroug zig-zag branches with the cross-veins. The externomedian vein is likewise strong, lying contiguous with the scapular branch on its basal portion. Two-thirds of the way toward the scapular branch it suddenly is deflected downward and branches at this point; both branches furcate repeatedly, the lower also connected with the hind margin of the wing by several off-shoots. Internomedian and anal veins poorly developed, occupying the much-reduced anal angle. All the veins connected by rather distant, more or less irregularly disposed cross-veins, which form a conspicuous reticulum with the broken nervures. Fore and hind wings nearly similar, the hind ones slightly broader.

Length without head 25^{mm}, size of wing about 40^{mm} by 10^{mm}.

One specimen, represented by the obverse and its reverse. Mazon creek, Ill., Carboniferous. From the Egan collection of the Chicago Academy of Sciences, No. 4749.

This is by far the best specimen of the ironstone fossils, the insect being preserved with the wings of the right side extended and not overlapping; the neuration is perfect.

Inasmuch as Dr. Scudder states that the figure of *Chrestotes lapidea* is erroneous in part, and elsewhere characterizes the genus as having the scapular vein and its main branch approximated, we shall have to regard the present specimen as excluded from this genus. With *Hemeristia* it therefore agrees in this character, and in the disposition of the main veins, but here the veins are straight and simply connected by transverse cross-veins, and exhibit no trace of reticulation. Thus the present genus is characterized briefly by the angular course of the veins and the prominent reticulation of the cross-veins.

Family *Gerarina* Scudder.

22. **Gerarus danae** Scudder.

Geol. Surv. Ill., Vol. III, p. 566, Fig. 1.

There is in the university collection what we have reason to believe is the type of this species, inasmuch as the strange outline of the body together with the general neuration is as depicted in the figure. However, the shape of the rather large and rounded stone is quite different from that in Dr. Scudder's illustrations. Should this be the type, a slight error has been committed in figuring the termination of the mediastical vein. Toward the tip, this becomes irregular, owing to its flexture at each cross-vein. This might lead one, especially in a poorly preserved specimen, to suppose that the mediastinal terminates in the scapular vein, or, as in *Xenoneura antiquorum* Scudder or *Dictyoneura libelluloides* Gold., that it ends in a cross-vein rectangularly bent, its upper half somewhat the longer. However, in such a case the great length of the mediastinal vein, together with the numerous under-branches of the scapular, would easily lead one to recognize its affinities with this family.

Type. Pal. Coll. No. 9245.

In addition to the twenty-three species here enumerated there is still another specimen exhibiting a wing shaped like that of *Paralogus æschnoides* Scudder, but of which the neuration is obscured.

EXPLANATION OF THE PLATES.[1]

PLATE V.

FIG. 1. *Hadrachne horribilis*, g. et sp. n.
FIG. 2. *Architarbus rotundatus* Scudd.
FIG. 3. *Geraphrynus carbonarius* Scudd.
FIG. 4. *Kustarachne sulcata*, sp. n.
FIG. 5. *Kustarachne exstincta*, sp. n.
FIG. 6. *Dipeltis diplodiscus* Pack.

PLATE VI.

FIG. 1. *Dictyoneura clarinervis*, sp. n.
FIG. 2. *Cheliphlebia extensa*, sp. n.
FIG. 3. *Eucœnus mazonus*, sp. n.
FIG. 4. *Eucœnus attenuatus*, sp. n.
FIG. 5. *Dieconeura maxima*, sp. n.
FIG. 6. *Petromartus indistinctus*, g. et sp. n.
FIG. 7. *Protodictyon pulchripenne*, g. et sp. n.

PLATE VII.

FIG. 1. *Hadrachne horribilis*, g. et sp. n.
FIG. 2. *Architarbus rotundatus* Scudd.
FIG. 3. *Geraphrynus carbonarius* Scudd.
FIG. 4. *Kustarachne sulcata*, sp. n.
FIG. 5. *Kustarachne exstincta*, sp. n.
FIG. 6. *Dipeltis diplodiscus* Pack.
FIG. 7. *Paolia gurleyi* Scudd.
FIG. 8. *Dictyoneura clarinervis*, sp. n.
FIG. 9. *Cheliphlebia extensa*, sp. n.
FIG. 10. *Eucœnus mazonus*, sp. n.
FIG. 11. *Eucœnus attenuatus*, sp. n.
FIG. 12. *Petromartus indistinctus*, g. et sp. n.
FIG. 13. *Petromartus indistinctus*, restoration of fore wing. *Md*, mediastinal; *Sc*, scapular; *Em*, externomedian; *Im*, internomedian; *A*, anal.
FIG. 14. *Dieconeura maxima*, sp. n.
FIG. 15. *Dieconeura maxima*, fore wing restored.
FIG. 16. *Dieconeura maxima*, hind wing restored. *Mg*, marginal vein; other letters as in Fig. 13.
FIG. 17. *Protodictyon pulchripenne*, g. et sp. n.

AXEL LEONARD MELANDER.

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[1] All figures are natural size.